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ScienceDirect

Procedia - Social and Behavioral Sciences 91 (2013) 661 – 672

Procedia Social and Behavioral Sciences

PSU-USM International Conference on Humanities and Social Sciences

A Preliminary Study of Noise Exposure among Grass Cutting Workers in Malaysia

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Abstract

The purpose of this study is to determine noise exposure among grass cutters. Eighteen grass cutters were monitored for 8 hours each, using the Noise dose meter. The workers were exposed to noise levels ranging from 84.3 dB(A) to 92.3 dB(A), TWA (mean 88.0 dB(A). The L_{max} value ranged from 100.4 dB(A) to 126.5 dB(A) (mean 109.5 dB(A)). 27.8 % workers exceeded the permissible level 90 dB(A), and 83.3 % exceeded the action level 85 dB(A). Audiometric test for both ears showed some evidence of mild to moderate hearing impairment in some workers (5 out of 18). This study revealed that some workers were exposed to excessive noise level and were at risk of acquiring noise induced hearing loss.

Keywords: Grass cutting; Workers, Noise Induced Hearing Loss; Audiometric test; Malaysia

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doi:10.1016/j.sbspro.2013.08.467

1. Introduction

Occurrences of noise induced hearing loss (NIHL) have been associated with workers exposed to noisy environment. Nelson et al. [1] stated that 16% of the workers globally suffered hearing loss associated with exposure at work. The prevalence of hearing impairment among uniformed workers such as the policemen, military and naval personnel was reported by Toh et al. [2], Able [3], and Ingle et al. [4]. In heavy industries, Harmadji and Kabullah [5] reported noise exposure among workers at steel factories in Indonesia; Boeteng et al. [6] and Omokhodion et al. [7] reported on workers' exposure in Africa; Bedi [8] reported the textile workers' exposure in India and Lu et al in China [9]. Neitzel et al. [10] reported exposure among the construction workers in Washington State, USA. In the transportation sector, Aslam et al. [11] described the risk of exposure among public transport drivers. In the rural and agricultural environment, Miyakita et al. [12] and Human et al. [13] reported that farmers, on occasion, were exposed to levels above the recommended level. Many more industries not mentioned above indicated that workers were at risk of exposure to excessive noise level and are prone to hearing impairment.

In Malaysia, to protect the workers from excessive exposure to noise, the hearing conservation program was introduced under the Factories and Machinery (Noise Exposure) Regulation 1989 [14]. Under this regulations, workers are protected from excessive noise exposure and reducing the risk of NIHL. According to the Factories and Machinery (Noise Exposure) Regulation 1989, for the permissible exposure limit, the employee shall not be exposed to noise level exceeding equivalent continuous A-weighted sound pressure level of 90 dB(A) or exceeding the limits specified in the First Schedule or exceeding daily dose of unity. No employee shall be exposed to noise level exceeding 115 dB(A) at any time. The 85 dB(A) is adopted as a criterion for action (action level). When the action level is reached or exceeded, it necessitates implementation of activities to reduce the risk of noise-induced hearing loss. Hashim et al [15] pointed out that the number of noise induced hearing loss reported to the Social Security Organization (SOCSO) are small, reflecting underreporting or failure to capture workers' morbidities especially in the small and medium size enterprises (SME) in Malaysia. The report recorded 8 cases in 1999, 59 cases in 2002, and 1 case in 2003.

According to the U.S. National Institute of Occupational Safety and Health [16], the recommended exposure limit (REL) for occupational noise exposure is 85 dB(A) time weighted average (TWA). Exposures at or above this level are considered as hazardous. They differed from the U.S. Occupational Safety and Health Act (OSHA) [17] which uses 90 dB(A) TWA. The rationale is to offer greater protection to noise-exposed workers, citing research that indicates an 8% excess risk of hearing loss at the 85 dBA TWA limit as opposed to 25% at 90 dB(A). The TWA is the averaging of different exposure levels during an exposure period. The REL for an 8-hr work shift is a TWA of 85 dB(A) using a 3-decibel (dB) exchange rate. The Malaysian Noise Exposure Regulation 1989 adopted a 5 dB exchange rate.

The climate of Malaysia is equatorial, characterized by high but uniform temperatures (ranging from 23° to 31° C throughout the year), high humidity, and abundant rainfall (averaging about 2500 mm annually). Due to favorable condition for rapid grass growth, grass cutting is required all year around. Grass cutting services in Malaysia is considered as a small to medium enterprise (SME) and it is a booming business. Grass cutting services are available from individuals who went from house to house offering their services. Most of them performed this work during weekends, as a mean of getting extra income. For privately owned grass cutting companies, they usually employed several workers and services are rendered to public or private organizations whereby cutting activities were carried out daily. To date, there has been limited study on noise exposure among grass cutters in Malaysia. General observation indicates these workers did not wear hearing protection while

performing the work despite being in close proximity to noisy equipment. The purpose of this study is to evaluate the noise exposure level among grass cutting workers and determine the status of their hearing.

2. Materials and Methods

2.1 Subjects

This study was conducted in one of the Malaysia's public university, Universiti Putra Malaysia, in 2007. Prior to monitoring, permission to carry out the study was obtained from the Division of Development. The university hired two private contractors for grass cutting services. Each contractor employed nine workers. All 18 workers were male. All were full time workers. Nine of the workers worked within the main campus (academic) areas and the other half worked at the students' residential halls and the golf course compound. The workers age ranged from 19 to 42 years. Half of the workers worked 6 days in a week and the others 7 days a week. All were full time contract workers. Majority of them have been cutting grass for more than 1 year; except for one worker (worker 16) who started 3 months ago. Their typical workday begins at 8 am and lasted until 4 pm. They took three breaks; 10.00-10.30am, 12.00-1.30pm and 3.00-3.30pm. Table 1 describes the schedule for workers recruited in this study. All workers used similar grass cutting equipment, Model TL 33, Mitsubishi (Figure 1).

Figure 1: A worker at work and the grass cutting equipment (Model TL 33, Mitsubishi).

2.2 Instrumentation and data collection

The noise exposure monitoring was conducted in December 2006, using noise dose meter (B&K, Type 4442). The microphone was attached to a worker's collar. The meter was secured in a breast pocket, to a belt or waistband. All subjects carried the dosimeter throughout their working hours. The calibration standards and procedures strictly followed the manufacturer's guideline [18]. The calibration range was between 109.9 dB(A) to 110.1 dB(A). Each worker was monitored for 8 hours starting from 8 am to 4 pm. The data was recorded

during the work and rest time.

2.3 Audiometric test

The audiometric testing was performed by trained personnel. Pure tone audiometric was performed for both ears at 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 6 and 8 kHz. Hearing loss can occur in the low frequency (0.5-2 kHz), high frequency (4-8 kHz) or both. The World Health Organization [19] categorizes hearing impairment as follows: normal hearing (<25 dB hearing level (HL)), slight (26-40 dB HL), moderate (41-60 dB HL), severe (61-80 dB HL), and profound (>81 dB HL).

Table 1: Workers' work pattern

Worker	Age	Years working	Work days/week	Work area
1	29	2	7	Residential Halls and golf course
2	25	2	7	Residential Halls and golf course
3	26	5	7	Residential Halls and golf course
4	27	2	7	Residential Halls and golf course
5	40	4	7	Residential Halls and golf course
6	28	2	7	Residential Halls and golf course
7	24	2	7	Residential Halls and golf course
8	42	4	7	Residential Halls and golf course
9	22	2	7	Academic areas
10	23	2	6	Academic areas
11	20	3	6	Academic areas
12	22	2	6	Academic areas
13	21	2	6	Academic areas
14	19	4	6	Academic areas
15	24	2	6	Academic areas
16	31	3 (month)	6	Academic areas
17	23	1	6	Academic areas
18	26	4	6	Academic areas

3. Results

3.1 Noise exposure monitoring

Table 2 summarizes the TWA and L_{max} values for the full 8 hour work for all workers. Our survey shows that the workers were exposed to noise levels ranging from 84.3 dB(A) to 92.3 dB(A) TWA (mean 88.0 dB(A)). The L_{max} value ranged from 100.4 dB(A) to 126.5 dB(A) (mean 109.5 dB(A)). From this study, five workers (27.8 %) were above 90 dB(A) Malaysian permissible level: worker 5 (91.4 dB(A)), worker 7 (92.3 dB(A)), worker 9 (90.3 dB(A)), worker 13 (91.7 dB(A)), and worker 16 (90.9 dB(A)). Fifteen workers (83.3 %) exceeded the action level of 85 dB(A). Four workers were exposed to L_{max} above 115 dB(A): worker 2 (115.2 dB(A)), 4 (116.9 dB(A)), 8 (119.5 dB(A)), and worker 15 (126.5 dB(A)). This does not comply with the

Malaysian Factories and Machinery (Noise Exposure) Regulation 1989 which states that no employee shall be exposed to noise level exceeding 115 dB(A) at any time. From our survey, it shows that five out of 18 (27.8 %) of the workers exceeded the permissible level. Our study revealed that some workers were exposed to excessive noise level and were at risk of acquiring NIHL.

3.2 Audiometric evaluation

To see whether these workers were suffering from hearing impairment, they were called in for audiometric evaluation. The hearing levels were tested at 0.25, 0.5, 0.75, 1, 1.5, 2, 3, 4, 6 and 8 kHz. Seventeen workers were tested; one worker failed to attend. Based on the audiometric testing, eleven workers showed no evidence of hearing impairment. Five workers showed evidence of hearing impairment, as shown in Figures 2(a) – 2(f.).

From the audiogram (Figure 2a), Worker 2 shows normal hearing at the right ear. For the left ear, he suffered slight hearing impairment at frequencies 1.5 – 2 kHz and at 4 - 8 kHz. At the frequencies of 6-8 kHz, his impairment declined to moderate. His exposure level was 89.9 dB(A) TWA and L_{max} 115.2 dB(A).

For worker 4 (Figure 2b), for the right ear, there was no evidence of impairment at low frequencies (<1 kHz) but suffered moderate impairment at 1.5 kHz, (25 dB HL difference) and continued to decline to moderate impairment at frequencies 2 kHz and above. For his left ear, there was 30 dB HL difference from 1 kHz to 1.5 Hz. He suffered moderate to severe impairment at 4 kHz – 6 kHz. His exposure level was 85.5 dB(A) TWA and L_{max} 116.9 dB(A).

For worker 8 (Figure 2c), the audiogram shows that the hearing abilities of both ears are normal as 0.25 - 4 kHz. However, there was an evidence of slight impairment at 6-8 kHz in his left ear. A notch occurred at 4 kHz to 6 kHz, a difference of 30 dB HL. The audiogram for his right ear appears slight impairment at 6 kHz. His exposure level was 86.0 dB(A) TWA and L_{max} 119.5 dB(A). Figure 2d is the comparison between Worker 3, who is considered not having hearing impairment with worker 8.

For worker 13 (Figure 2e), the audiogram for his left ear shows light impairment within all the frequencies (0.25- kHz) and his left ear a moderate impairment also within all frequencies. His exposure level was 91.7 dB(A) TWA and Lmax 101.0 dB(A).

Finally, worker 15 (Figure 2f), there was no evidence of impairment in his right ear at all the frequencies except for slight impairment appears as 250 Hz in his audiogram. For his left ear, he suffered moderate impairment at frequencies below 1 kHz. At 1 kHz – 4 kHz, his impairment declines from moderate to severe, but at 4 k Hz, the audiogram chart recorded 85 dB HL (profound impairment). At 6 and 8 kHz, the hearing levels were recorded at 70 dB HL and 75 dB HL respectively (severe impairment). His exposure level was 84.5 dB(A) TWA and L_{max} 126.5 dB(A).

Table 2: Noise measurement among the grass cutting workers measurement for 8-hour period and evidence of hearing loss base on audiometric readings.

Workers ID	TWA dB(A)	L_{max} dB(A)	Right ear	Left ear
1	87.2	107.1	normal	normal
2	89.9	115.2	normal	slight
3	87.9	107.5	normal	normal
4	85.5	116.9	moderate	moderate to severe
5	91.4	107.9	normal	normal
6	88.5	113.8	normal	normal
7	92.3	105.8	normal	normal
8	86.0	119.5	normal (except almost slight impairment at 6 kHz)	Normal (except slight impairment at 6-8 kHz)
9	90.3	100.4	normal	normal
10	85.7	104.6	normal	normal
11	89.6	113.5	normal	normal
12	84.7	112.2	not done	not done
13	91.7	101.0	moderate	slight
14	87.7	103.3	normal	normal
15	84.5	126.5	normal (except slight impairment at 250 kHz)	severe to profound
16	90.9	108.5	normal	normal
17	86.0	104.7	normal	normal
18	84.3	101.8	normal	normal
Mean	88.0	109.5		
Sd.	2.7	7.0		
Range	84.3 -92.3	100.4 -126.5		

Hearing impairment: normal hearing (<25dB HL), slight (26-40 dB HL), moderate (41-60 dB HL), severe (61-80 dB HL), and profound (>81 dB HL) (WHO, 1991).

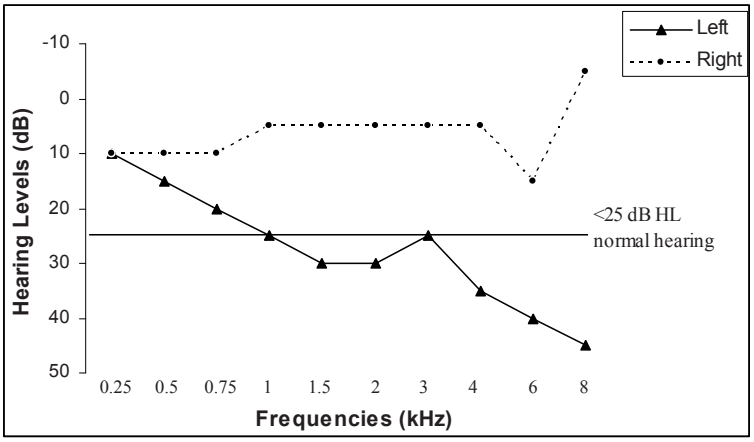

Figure 2(a): Audiogram chart for Worker 2

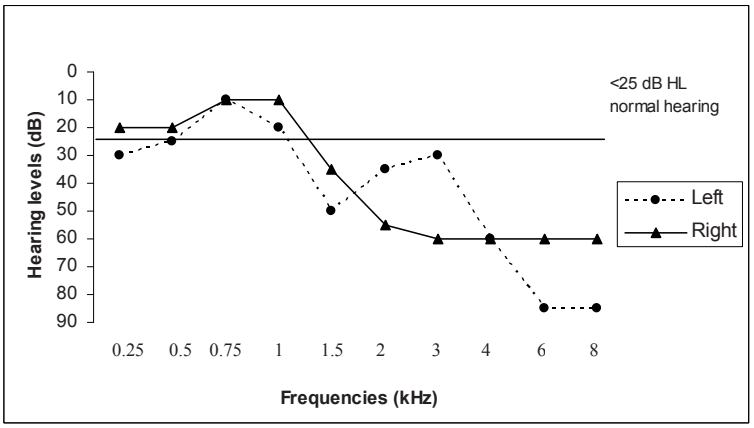

Figure 2(b): Audiogram chart for Worker 4

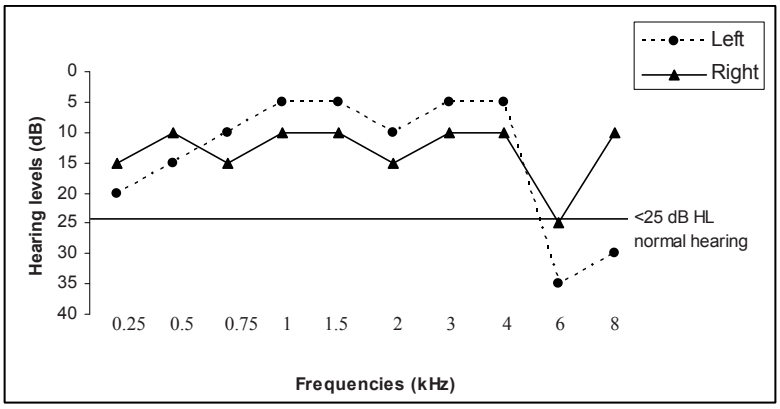

Figure 2(c): Audiogram chart for Worker 8

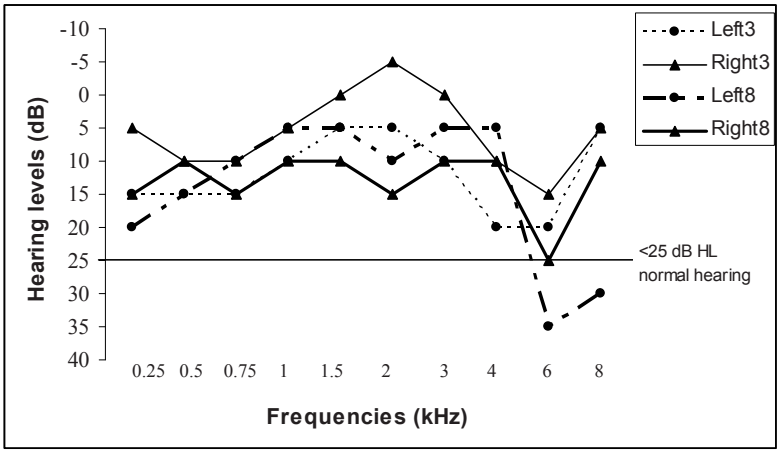

Figure 2(d): Comparison between audiogram worker 3 (normal hearing) and worker 8

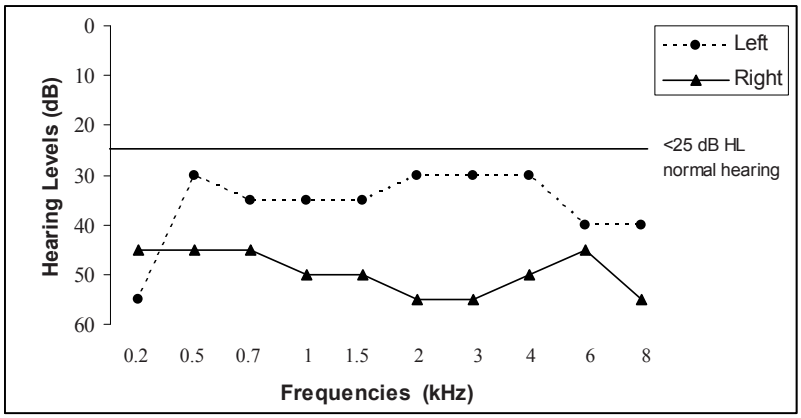

Figure 2(e): Audiogram chart for Worker 13

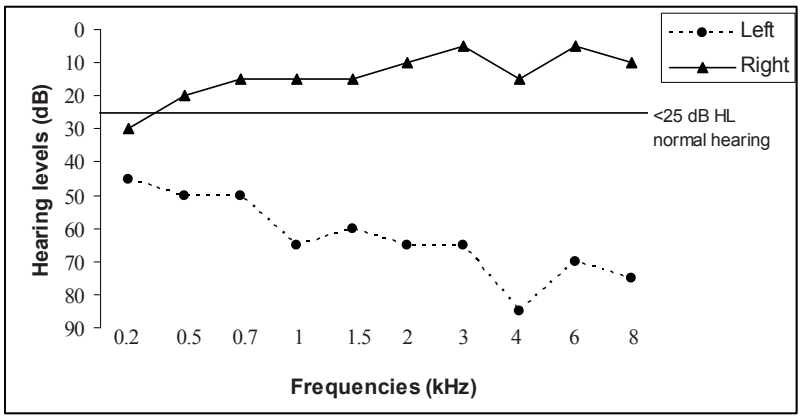

Figure 2(f): Audiogram chart for Worker 15

4. Discussions

Hearing abilities are also affected by a variety of other factors such as age, chemical exposure, noise exposure in leisure time (such as hobbies), and vibration. Hearing ability decreases as age progresses. Pyykko et al. [20] had identified age as one of the individual risk factors for sensory neural hearing loss (SNHL) among forest workers who handled chainsaws while research by Szanto and Liagi [21] found that hearing loss induced among elderly miners in Romania was more pronounced compared to younger miners. The mean hearing threshold level (HTL) for the 40- 46 age group workers produced a decrease in HTL at frequencies 4, 6 and 8

kHz (22). A study by Ferrite and Santana [22] also found that age is positively associated to hearing loss among metal processing factory workers in Brazil, with prevalence ratio of 4.02 for workers older than 40 years. Our study was not able to show such a trend because all of the workers were in their twenties except for three workers who were above 30 years old. Of the five who showed evidence of hearing impairment, only one (worker 8) is 42 years old but others were in 21 – 27 years old.

Morata's [23] study have shown that hearing frequencies are affected by chemical exposure even when noise and chemicals are at permissible level. Chemicals such as xylene, ethyl benzene, h-hexane, tricloroethane, carbon monoxide has ototoxic properties. Morata et al. [24] and Sliwinska-Kowalska et al. [25] reported that animal studies have shown that these chemicals interact synergistically with noise or potentiate its effect on auditory system. Workers exposed to chemicals have significantly poorer pure-tone thresholds compare to those not exposed. From our survey, our subjects did not indicate that they have the history of being exposed to solvents.

Noise exposure in leisure time such as exposure to loud music can affect hearing. Jaffer and Razi [26] reported that walkman users showed evidence of hair cell damage in cochlea. Their study indicated that subjects who listened to the Walkman for a longer duration, exposed to intensity of at least 90- 100 dB, their amplitude of distortion product oto-acoustic emission were worse than those who do not use the Walkman. The distortion product oto-acoustic emission test) indicated that it was more sensitive that pure tone audiogram because none of the subjects showed evidence of impairment base on their audiogram.

Hand arm vibration has also been shown to be positively associated with hearing loss. In addition to age, Szanto and Ligia [21] also reported presence of vibration induced white finger (VWF) among forest workers who handled chainsaws (inside earmuffs 98.9 dB(A)); acceleration vibration of 11 m/sec^2), which has been identified as the second major risk factor associated with SNHL. Miners who suffered VWF as the result of handling pneumatic hammers (L_{eq} 96 dB (A); acceleration vibration of 15-17.5 m/sec^2) had higher HTLs compared to workers without VWF. The difference is highest as 4, 6 and 8 kHz. Zu et al. [27] tested healthy individuals who were exposed to noise level 90 dB(A) and vibration 30 m/s^2 at 60 Hz showed that vibration alone did not produce a significant increase in temporary threshold shift (TTS). Exposure to noise and a combination of vibration and noise increases TTS. The changes were detected at all frequencies tested, the highest at 4 and 6 kHz. Exposure to noise, without vibration, produced lower TTS. Our study, however, did not measure vibration. From field observation we believe that these workers were exposed to both noise and vibration. We recommend future studies to explore the effect of noise and vibration on hearing loss among grass cutters.

Hearing Protection Aid

All workers indicated that they did not put an ear protection during work. When asked why they did not wear any protection, 16 of the workers (88.9 %) mentioned that their employer did not supply any ear protectors to them. When asked whether they would wear them if provided, they responded that they will not although they knew about the possibility of hearing loss. Among the reasons given for not wearing is that they are not comfortable. A study in Nigerian steel workers by Olege et al. [28] poor that availability of hearing protection and its usage was poor. The same scenario was observed in the Malaysian factories where Maisarah and Said [29] reported that although 80% of the factory workers were provided with hearing protection devices, only 5 % wore them regularly. These two studies, as well as ours, indicate the non-compliance of using hearing protection devices in the developing countries. Since evidence indicates that they were exposed to high noise levels, there is

a possibility of them acquiring NIHL. To avoid this, we suggest that the workers be educated on the importance of wearing hearing protector and also enough rest periods be given to them in order to prevent them from acquiring NIHL.

Although some of these workers showed evidence of tendencies to have impairment or impairment, we do not have evidence to indicate that it is caused by excessive noise exposure related to their work. We can only speculate that they are at risk of acquiring NIHL because the noise generated by the most of the cutting machine were recorded above 85 dB(A).

5. Conclusion

From the 8-hr exposure monitoring on all subjects, our results indicate that that five out of 18 (27.8 %) of the workers exceeded the permissible level 90 dB(A), and 15 out of 18 (83.3 %) exceeded the action level 85 dB(A). Based on the audiometric evaluation, two workers showed evidence of impairment in either ear. Three workers showed evidence of impairment in both ears. We could not, however, establish the causal effect relationship. Our data merely indicates the current hearing status of these workers. Although this study used small number of subjects, our study revealed that some workers were exposed to excessive noise level and were at risk of acquiring NIHL.

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